Appendix H

POST Tools Project

C3 Design Review

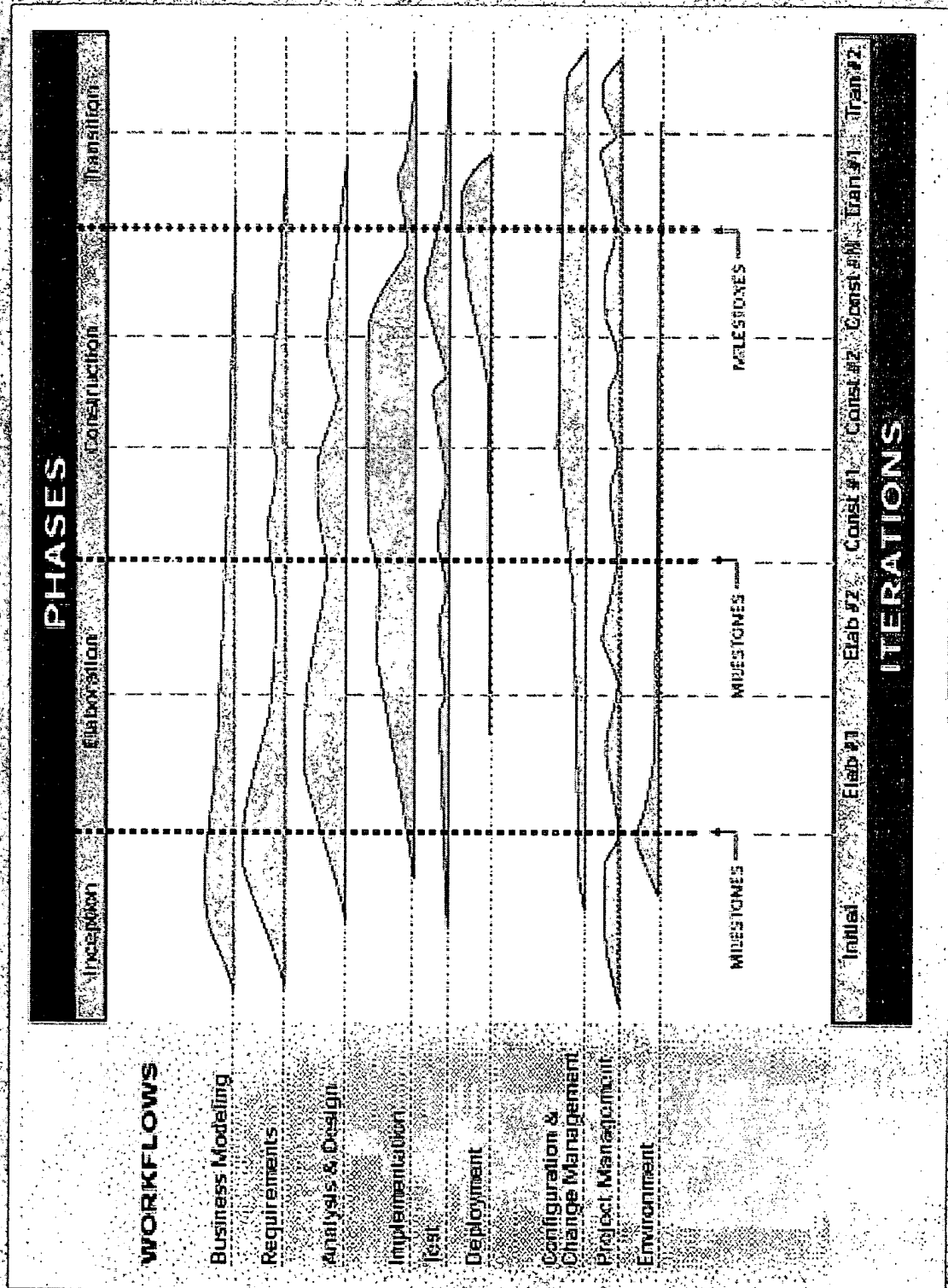PAYLOAD OPERATIONS SUPPORT TEAM · FIT TO FLY
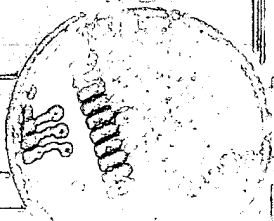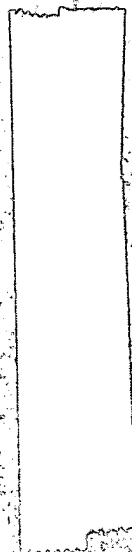
Agenda

- Project Overview
- Software Engineering
- Hardware Engineering
- Test Plans and Acceptance
- Summary
- Demonstrations

Project Overview

- Iterative process allowed early focus on architecture and risk
  - Mostly OiaB and CDT
- Later focus on completing scope
  - Mostly CDT, MOT, SMT, PDB
- Coordination with projects
  - PIT, Cargo PC, Flight Similar
- Pursued and chose COTS for SDR

Iterative Process

PHASES

WORKFLOWS	Inception	Elaboration	Construction	Transition

Business Modeling
Requirements
Analysis & Design
Implementation
Test
Deployment
Configuration & Change Management
Project Management
Environment

MILESTONES
MILESTONES
MILESTONES

Initial | Elab #1 | Elab #2 | Const #1 | Const #2 | Const #N | Tran #1 | Tran #2

ITERATIONS

Schedule

- √ Start — 11/01/99
- √ Inception Phase Complete — 12/15/99
- √ Lifecycle Architecture (SRR) — 04/12/00
- √ Design Review (PDR/CDR) — 07/26/00
- √ Release 0.0 (IOC) — 11/22/00
- √ Release 1.0 (RFQ) — 03/21/01
- • Design Review (C3) — 05/03/01
- • Release 2.0 (RFD) — 08/22/01
- • Transition Review (ORR) — 12/05/01
- • Product Release — 06/27/02

Metrics

- Capturing
  - Software complexity metrics
  - Snapshot metrics by iteration
  - Dynamic metrics across iterations
  - Artifact completion
- Calculating earned value with PX

State Measured at C2

- 61 change orders, 60 closed
- 113 use cases
- 5,116 widget points
- 6,255 source files
- 27,723 door hours
- 1,071,098 lines of code

Software Engineering

Custom Software
COTS Software

Custom Software

- Architecture complete
- CDT, MOT, PDB, SMT, and OIaB have custom elements
- Data model complete
- Product definitions complete
- Finishing scope during C3

COTS Software

- Wind River Systems VxWorks 5.4
- Wind River Systems MATRIX$_x$ 7.0
- Silver Stream Application Server 3.5.2
- Microsoft Visual Studio 6.0
- Microsoft Windows/NT 4 SP5
- Microsoft Visual Source Safe 6.0
- Microsoft SQL/Server 7.0
- Microsoft Internet Explorer 5.x+
- Intranet Solutions Xpedio Content Server 4.5
- Symantec pcAnywhere 9.2

Implementation Mapping
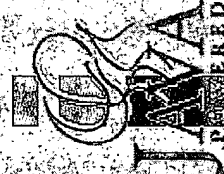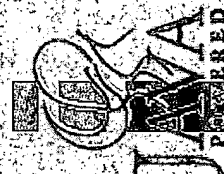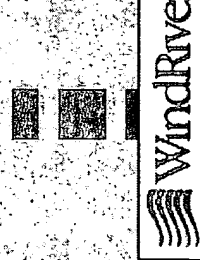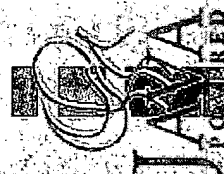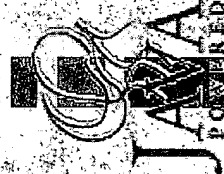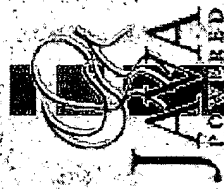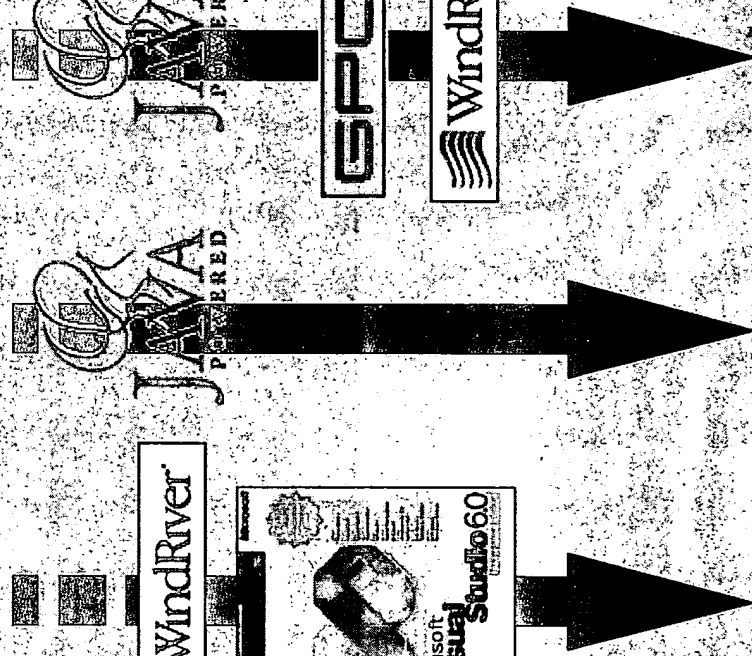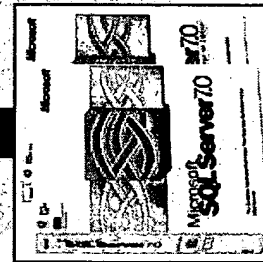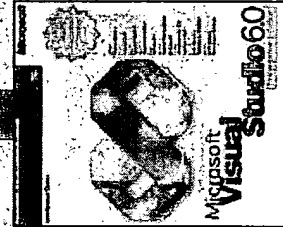
Command and Data Tool

- CDT-PIT IDD complete
- Remaining work
  - ° C2 Adjusted Requirements and Implementation
    - Changes to Data Collection Forms
  - ° C3 Scheduled Implementation
    - CDT-01C: NASA Reconstructed Formats
    - CDT-01C: Customer / NASA Format Mapping Summary
    - CDT-01D: Define Command Structures
    - CDT-01S: Parameter Review
    - CDT-01Q: Manage Standard Orbiter Parameters for WinDecom
    - CDT-07B: Additional Payload XML Products – Hazardous Command Structures and Standard Orbiter Parameters
    - CDT-11: Capture and Produce Annex 4 Text

Command and Data Tool

- Remaining work (continued)

  ○ Audit Capability Integration

    – CDT-10: Collect Audit Data Requirements - implement forms required to gather audit requirements (data record definition and audit rules)

    – CDT-09: Audit Payload Data - provide interface to gather and prepare data for audit tool

  ○ New Requirements

    – Generic MSID For P/L Applications Field Testing

Mission Operations Tool

- C3 use cases complete
- Combination blank books and DB
  - Enter table data through forms
    - ° User friendly data entry forms to capture book table data
  - Edit blank book text
    - ° Text entry through MS Word for product generation
  - Blank book linked to table data
    - ° Linked data tables in MS Word document for most recent data
  - CM as integrated package
    - ° Word document checked in and out of MOT database

Mission Operations Tool

MOT data entry

MOT
Data entry
form

MOT DB

Annex
Word doc.

MOT DB

Excel

MOT text entry
and product
generation
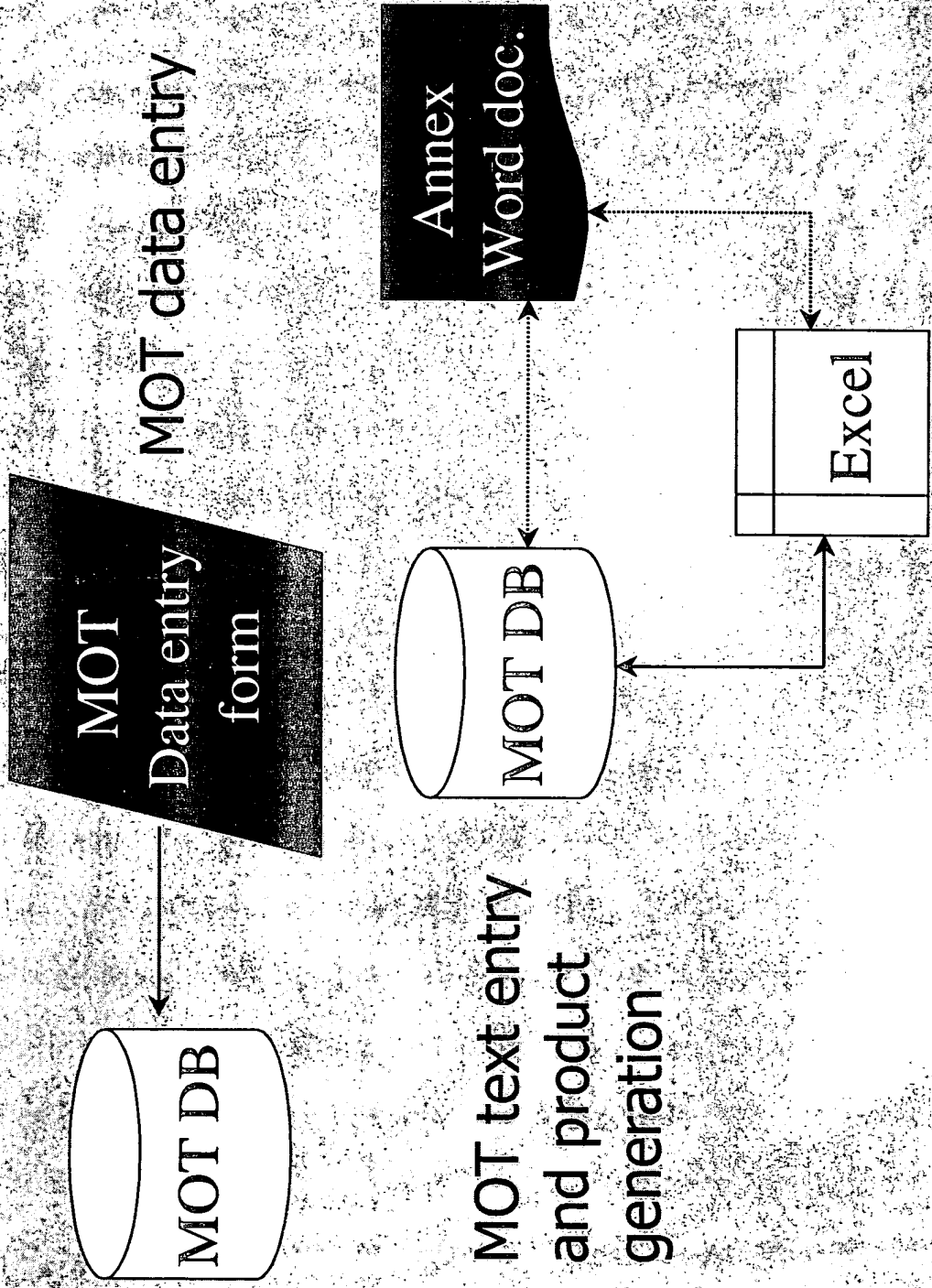
Mission Operations Tool

- Remaining work
  - Integrated test
  - Document schedule viewing for all documents

Orbiter-in-a-Box

- C3 use cases complete
- Remaining work
  - PSP implementation
  - MDM implementation
  - PDI reconfiguration implementation
  - Multi-GPC operation
  - Integrated test
  - Plug-n-Play Interfaces
  - Configurations tools, WEB pages, and Starter Scripts
  - Local file system layout

Orbiter-In-a-Box

- Capabilities
  - GPC Emulator
  - MIC Support
  - SMS Models
  - Hard or Soft Payload
  - ISP Server
  - Web Server
  - Payload Model Server
  - Task Manager

SMS Model Tool

- C3 use cases complete
- PLS compatibility verified
- PLS-OicB migration verified
- Remaining work
  - Incorporate PDB-ISP Links into Payload Model Templates
  - Integrated test

Top Level MatrixX Payload Model
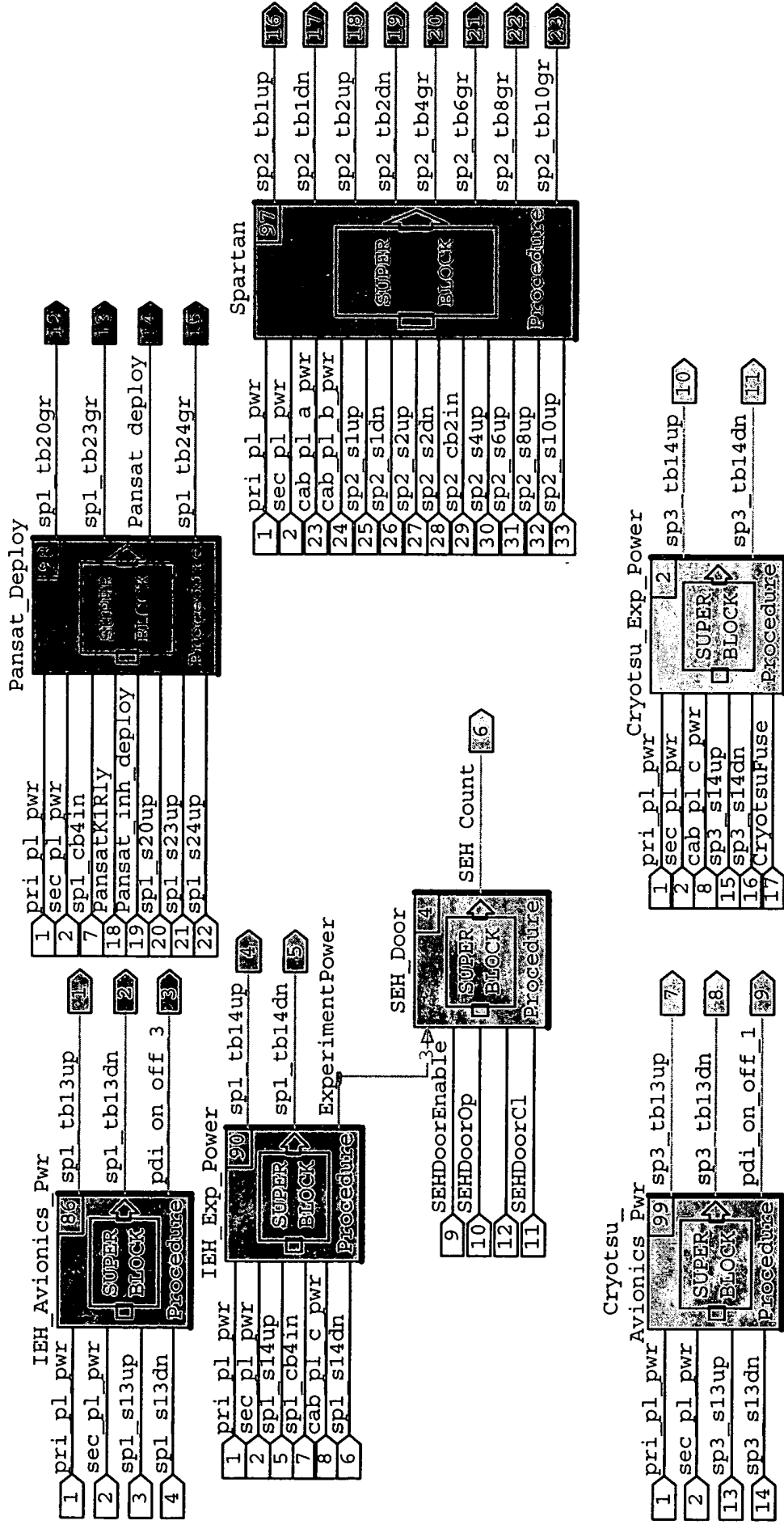
MatrixX Payload Model
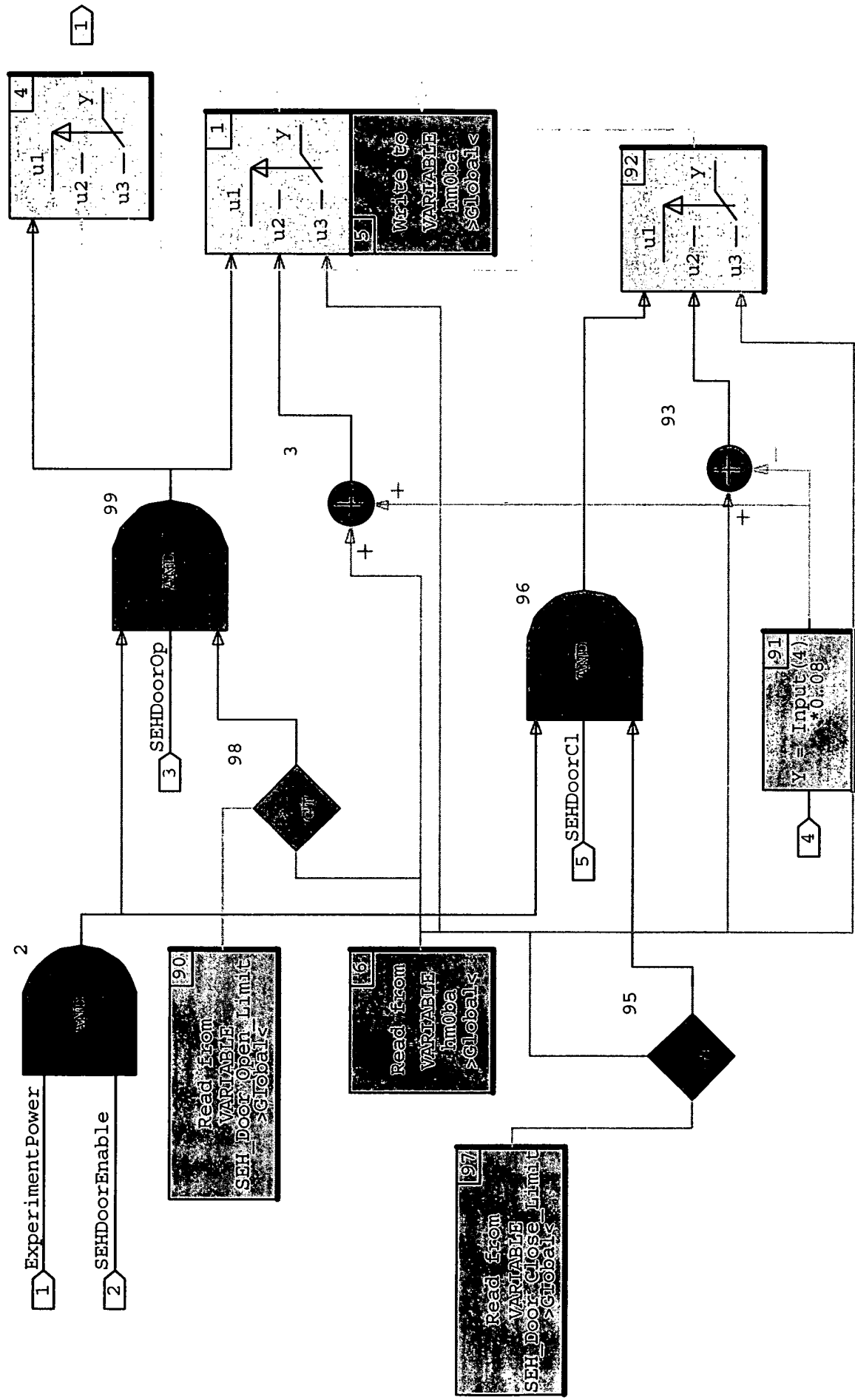
Interactive Controls Within MatrixX

SEHDoorRate

0.00

SEHCount

120.00

0.00

ssp3_tb14up

ssp3_tb14dn

ssp3_tb13up

ssp3_tb13dn

pd1_on_off_1

5.00

0.00

ssp1_s14up

ssp1_s14dn

ssp3_s14up

ssp3_s14dn

ab_pl_a_pwr   ab_pl_b_pwr

ssp1_s13up

ssp1_s13dn

ssp3_s13up

ssp3_s13dn

pri_pl_pwr

sec_pl_pwr

ab_plM_pwr

ssp1_cb4in

SEHDoorEnable

SEHDoorOp

Off
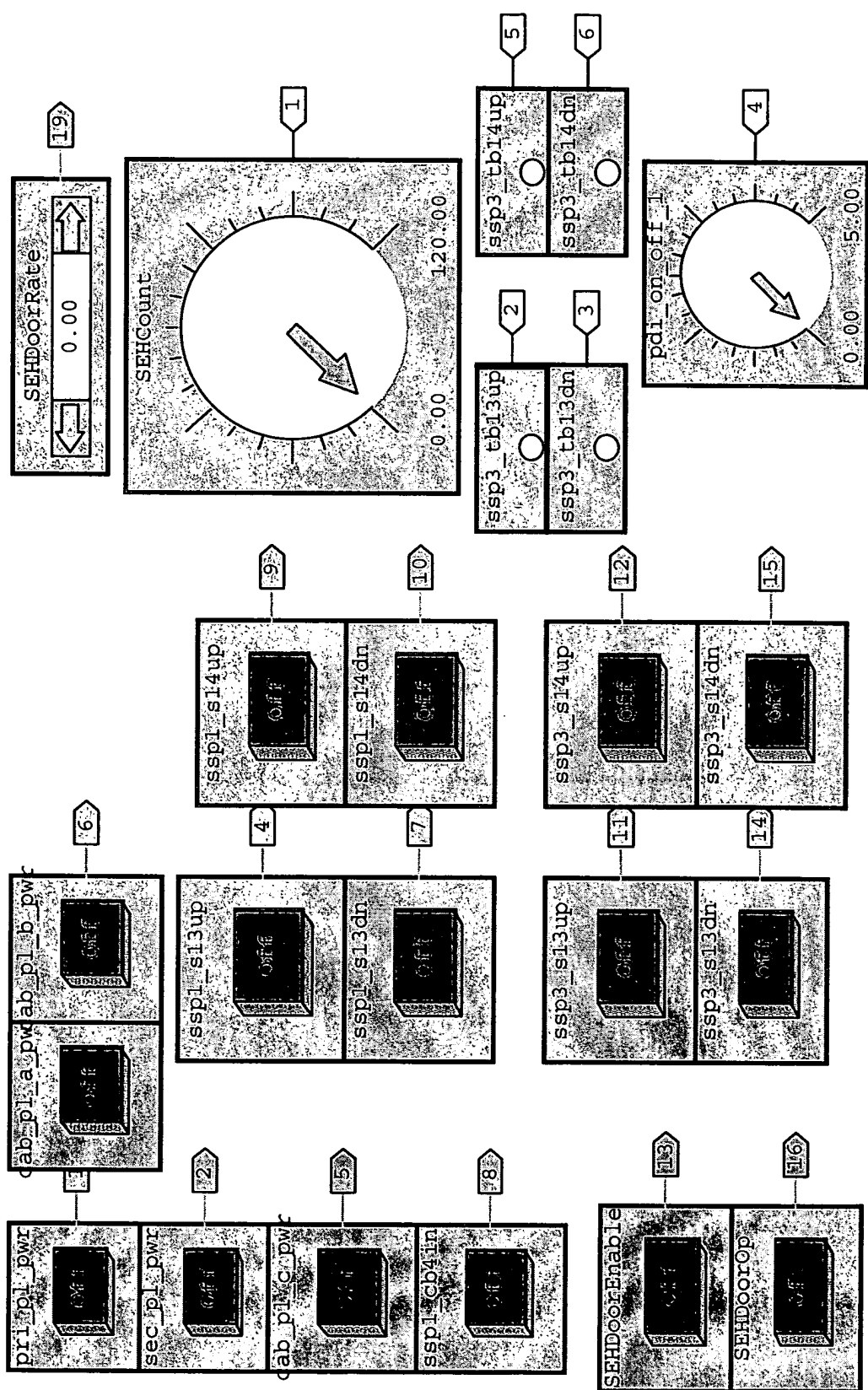
Portable Display Builder

- C3 use cases complete
  - Beans include:
    - Custom Time Clock
    - Meter / Gauge Dial Bean
    - Symbol Data Icon – Talkback bean
    - SMS Commanding – Publish Capability
    - Mskview – Matrix Bean
    - Icon Editor and Generic Bean
    - Action Object Icon
    - ISP NT Server Software Certified
    - Button Group
    - Slider Bar
    - Text – Data Driven Text
    - RtParameter Bean
    - ISP Data Provider Bean
    - Linear Meter Bean
    - Curved Line
    - Plot / Trend

- CPC platform support verified
- Remaining work
  - Complete Beans
  - Generic Format Editor
  - PDB Commanding

Shared Data Repository

- C3 use cases complete
  - Legacy import/export not in scope
- Implementation with Xpedio
- Remaining work:
  - Define workflows
  - POST graphics
  - VPN installation
  - Test

Implementation Details

- SDR is on the POST Server
- Content is viewable as PDF and html, where applicable
- Content is downloaded in native format
- Required metadata fields include the status of the document and entry into a workflow
- POST Server is protected by a VPN

Authentication

- User authenticates on the VPN using a digital certificate and password – protects the POST Server

- User authenticates with the SDR using an Xpedio username and password – protects content

SDR Content Access Controls

- Security Groups control access to different payloads
- Security Groups control access to "frozen" payload products
- Users belong to one or more Security Groups
- Users are assigned Roles in a Security Group
- Roles are: Admin, Contributor, Reviewer
- Permissions are assigned to each Role: Read, Write, Delete, Admin

Hardware Engineering

Custom Hardware

COTS Hardware
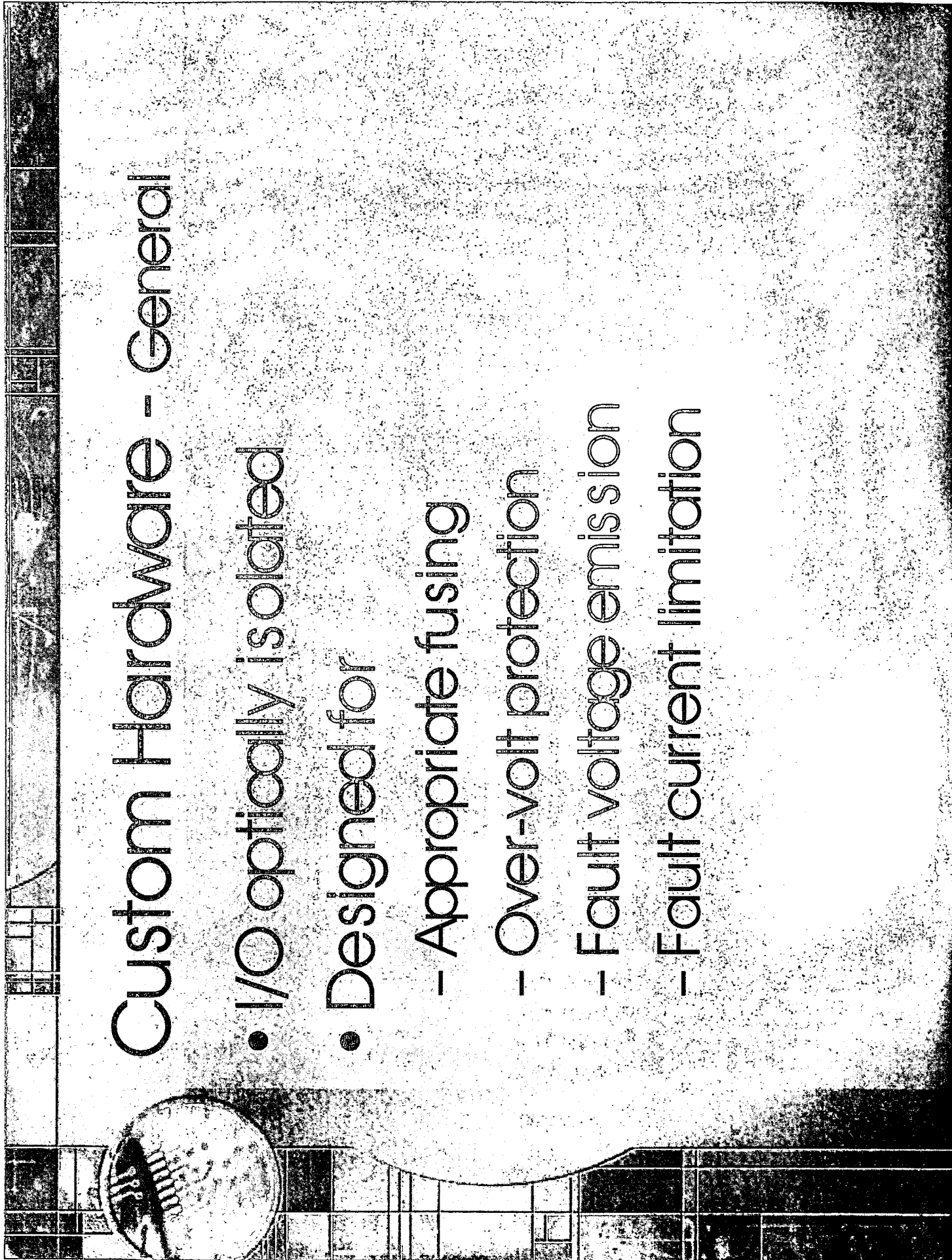
Orbiter In A Box - H/W

- **Two Unit System**
  - Unit #1 - COTS H/W
  - Unit #2 - Custom H/W. Special
  - Test Equipment (STE) per NSTS 07700

OIAB

STE
Unit #1

COTS
Unit #2

PRELIMINARY
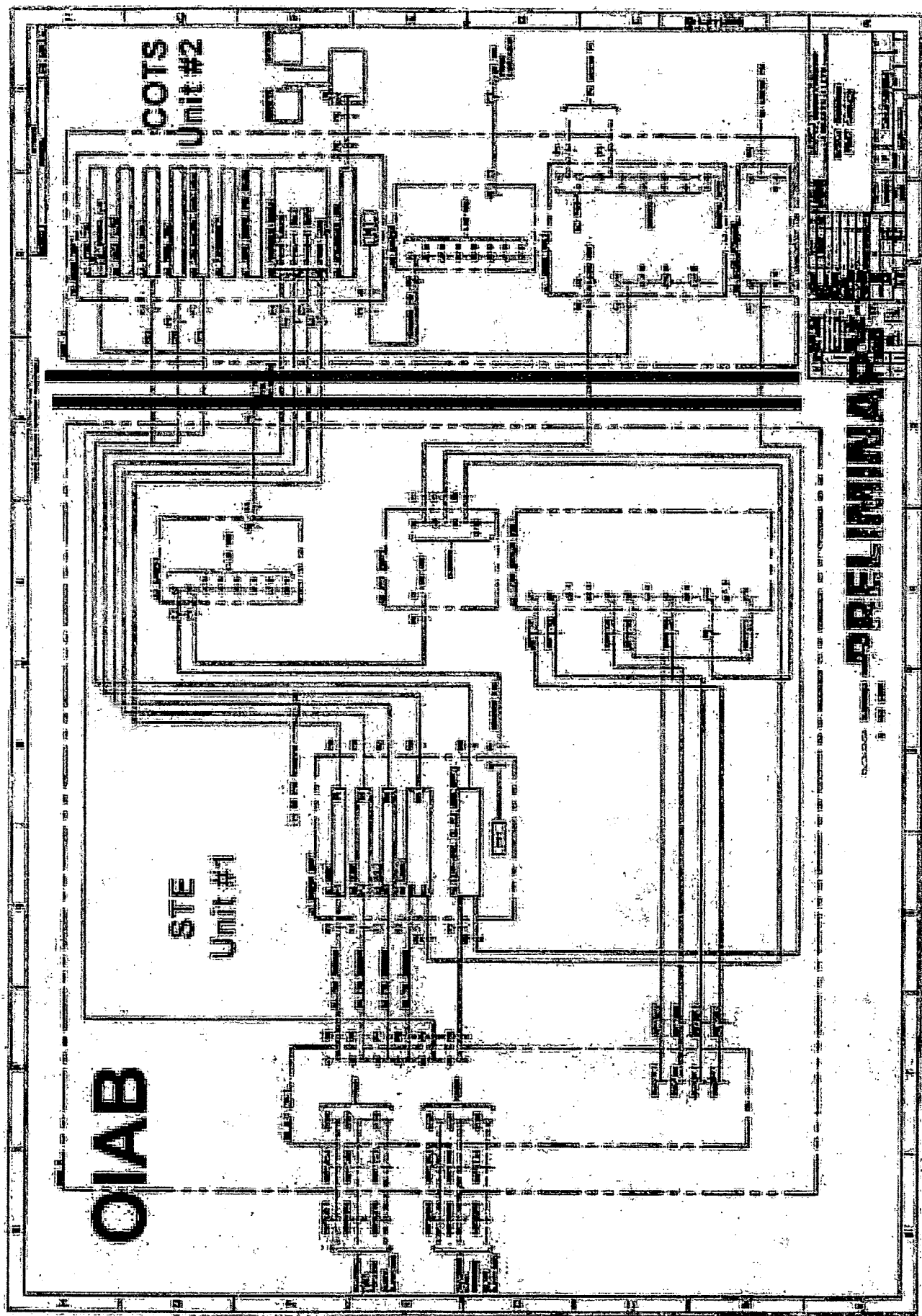
Custom Hardware - General

- I/O optically isolated
- Designed for
  - Appropriate fusing
  - Over-volt protection
  - Fault voltage emission
  - Fault current limitation

Custom Hardware

- Standard Switch Panel (SSP)
- Multiplexer/DeMultiplexer (MDM) I/O
- Payload Signal Processor (PSP)
- Payload Data Interleaver (PDI)
- Pulse Code Modulation Master Unit (PCMMU)
- Cargo PC
- Power
- Interfaces

Custom Hardware - SSP

- Fully functional Standard Switch Panels
- The SSPs duplicate flight panel
  - Simulation panels components used in place of flight components to reduce cost
  - Connectors Mil rated.
- Panels will be 19" rack mounted
- Design for 1 or 2 SSP panels per POST system

Custom Hardware – MDM I/O

- MDM Input and Output Cards
    - Low-level differential analog inputs (AID)
    - Low-level discrete inputs (DIL)
    - Low-level discrete outputs (DOL)
    - High-level discrete outputs (DOH)
- Signal conditioning accomplished on custom designed VME boards to duplicate Shuttle MDM characteristics
    - Input/output portion of Shuttle IOM boards duplicated
    - Boards driven by COTS I/O boards and will present the same electrical interface to Payload as flight equipment

Custom Hardware - ADI

- Two analog differential inputs
- Acromag IP320 12-bit high density analog input board provides input interface to the VME chassis backplane
- A POST custom designed VME board will provide Shuttle MDM IOM electrical interface to Payload

Custom Hardware – DIL

- Eight low-level discrete inputs TTL-5 volt
- Acromag IP440-1 32-Channel Isolated Digital Input Module with interrupts will provide the Input interface to the VME chassis backplane 4 to 18 volts
- A POST custom designed VME board will provide Shuttle MDM IOM electrical interface to Payload

Custom Hardware – DOL

- Eight low-level discrete outputs
- Acromag IP445 32-Channel Isolated Solid State Relay Discrete Output Module will provide the low level output interface to the VME chassis backplane
- A POST custom designed VME board will provide Shuttle MDM OM electrical interface to Payload

Custom Hardware - DOH

- Four high-level discrete outputs

- Acromag IP445 32-Channel Isolated Solid State Relay Discrete Output Module will provide the high level output interface to the VME chassis backplane

- A POST custom designed VME board will provide Shuttle MDM IOM electrical interface to Payload

Custom Hardware - SIO

- One MDM SIO port
- A SBS SDIO-PCM2-1 PCMIA card will supply the port
- The PCMIA card will be installed in the VGM5 single board computer board in the provided PCMIA slot.
- The SBS board was custom designed for this use and meets all orbiter specifications.
- The SIO signal will be interface to the Customer provided Cargo PC though a PDIP panel provided by POST.
  - It will provide the same panel connector as a flight PDIP panel.

Custom Hardware – PSP

- One command stream will be provided for the Payload
- SBS 4416vF PCM Simulator Card provides the PSP PCM output interface to the VME chassis backplane
- The SBS module provides a single ended 500 mv
- The orbiter PSP output is a differential 3.2 to 4.4 V P-P
- A custom designed/built interface will be provided to add convert from single ended to differential drive and to raise the signal level from 500 mv to 4 V P-P

Custom Hardware - PDI

- One Payload Data Interleaver port
- A SBS 4422-V64 with a 4400-TF Tunable Bit Synchronizer Module will provide PDI function
- The SBS boards do not meet following orbiter specs

  – Bit Rate - The PDI can process an input stream as slow as 10 bps, but the SBS bit sync card can only sync to streams as slow as 200 bps. By using separate clock and data inputs into the SBS 4422 card, the 10 bps rate can be achieved.

  – Master Frame Sync - The SBS 4422 card can not sync on a static master frame sync pattern. If there is an 8 bit minor frame counter, the start of the master frame can be determined.

Custom Hardware – PCMMU

- One command streams will be provided

- SBS 4416VF PCM Simulator Card provides the Pulse Code Modulation Master Unit (PCMMU) PCM output interface to the VME chassis backplane

- The SBS module provides a single ended 500 mv

- The orbiter PSP output is a differential 3.2 to 4.4 V P-P

- A custom designed/built interface will be provided to add convert from single ended to differential drive and to raise the signal level from 500 mv to 4 V P-P

- This signal will be provided to the Cargo PC with a partial Shuttle panel O5. The panel will only contain the PCMMU connectors.

Custom Hardware

- The Cargo PC with a PCMIA MDM-SIO port will be a customer provided item

- The only payload power which will be provided by OIAB will be power associated with the SSP and the MDM interface boards.

- The OIAB will provide Mil rated connections for customer provided cable to connect the POST to the Payload.

COTS Hardware

- Synergy single-board computers
- SBS avionics and telemetry cards
- Red Rock hard drives
- Ramix LAN switches
- Systran reflective memory network
- Acromag analog/discrete cards
- Backplanes, card cages, racks
- True Time time code generators
- Dell workstations, Compaq server
- Nokia VPN gateway, Check Point firewall

Cable Plan

- Customer provides
  - Payload-SIP
- SEMO provides
  - OiaB to SIP
  - OiaB "lite" to CPC
  - Network crossovers
- CPC provides
  - CPC to PDIP (MIC)
  - CPC to O5 (PCMMU, DC)

Operations Plan

Software

Hardware

Operations Flow

- OIABs and Tools PC depot in LSF
- SR to SEMO to ship
- SDR coordinator builds customer package
- Tools PC and OIAB configured for shipping-Acceptance/Checkout Test
- Units shipped. DRD 1149, 1602
- Field support to customer as required

Operations Flow - cont.

- Vendor updates tracked and implemented.

- Units received back from vendor and re-furbished.

Testing and Acceptance

Software

Hardware

Integrated

Software

- Test Plan
- Unit tests
- Test cases
- Manual test procedures
- Automated test scripts
- Non-functional tests

Hardware

- Custom hardware test per TPS
- Analysis support FMEA/CIL
- Integrated COTS test support

Integrated

- Configuration tests
- End-to-end tests
  - Process endpoints
  - HST-OiaB-CPC-PDB tests
  - SMT-OiaB-PDB tests
- Performance tests
- Integrated build tests

Summary

Summary

- Software nearing completion
- Hardware nearing completion
- Requirements are stable
- Eliminating risks and uncertainties
- Preparing ops and support workflow
- Focus on testing
- Focus on POST demonstration

Backup

SDR Access Control Example

- Jack belongs to security groups PL1 and PL2

- Jack's role is Contributor for PL1 and Reviewer for PL2.

- Jack can read and edit content that belongs to PL1.

- Jack can read content that belongs to PL2.

SMT AutoCode Code Segment from Previous Model

```
/******* Procedure: Cryotsu *******/

    void Cryotsu( )
    {

    /***** Local Block Outputs *****/
    RT_INTEGER ExperimentPower;

    /***** Output Update. *****/
    /*——————————— Procedure Super Block */

    /* [IEH_Avionics_Pwr:86] */

    IEH_Avionics_Pwr();

    /*——————————— Procedure Super Block */
    /* [IEH_Exp_Power:90] */

    IEH_Exp_Power(&ExperimentPower);

    /*——————————— Procedure Super Block */

    /* [SEH_Door:4] */

    SEH_Door(ExperimentPower);

    /*——————————— Procedure Super Block */

    /* [Cryotsu_Avionics_Pwr:99] */

    Cryotsu_Avionics_Pwr();

    /*——————————— Procedure Super Block */

    /* [Cryotsu_Exp_Power:2] */

    Cryotsu_Exp_Power();

    /*——————————— Procedure Super Block */

    /* [Pansat_Deploy:98] */

    Pansat_Deploy();

    /*——————————— Procedure Super Block */

    /* [Spartan:97] */

    Spartan();

    return;
```